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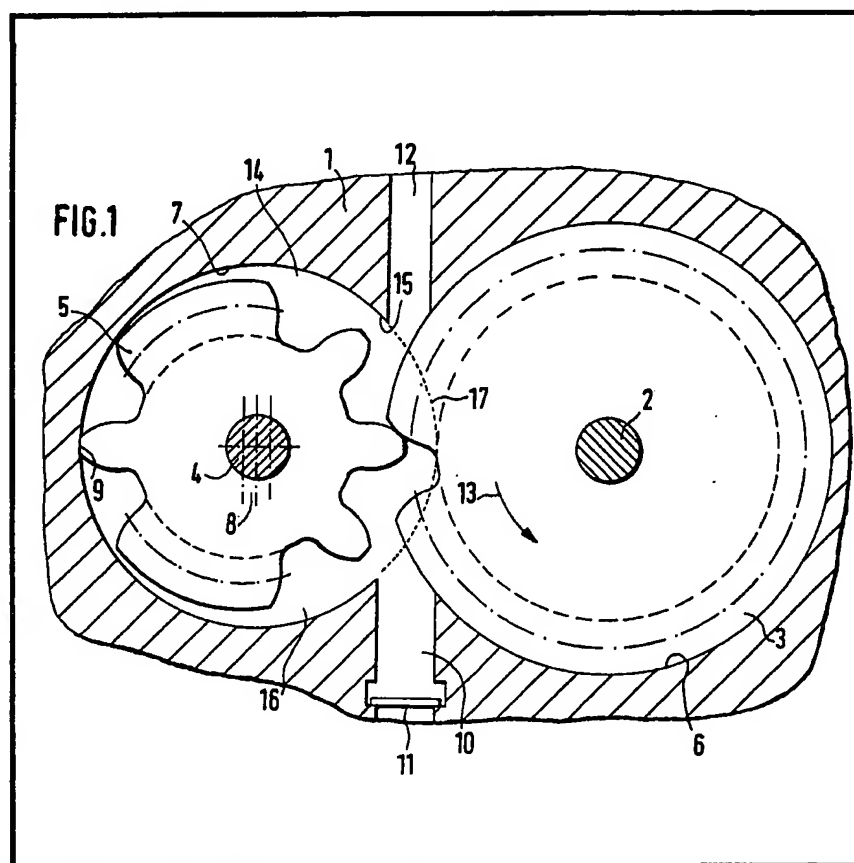
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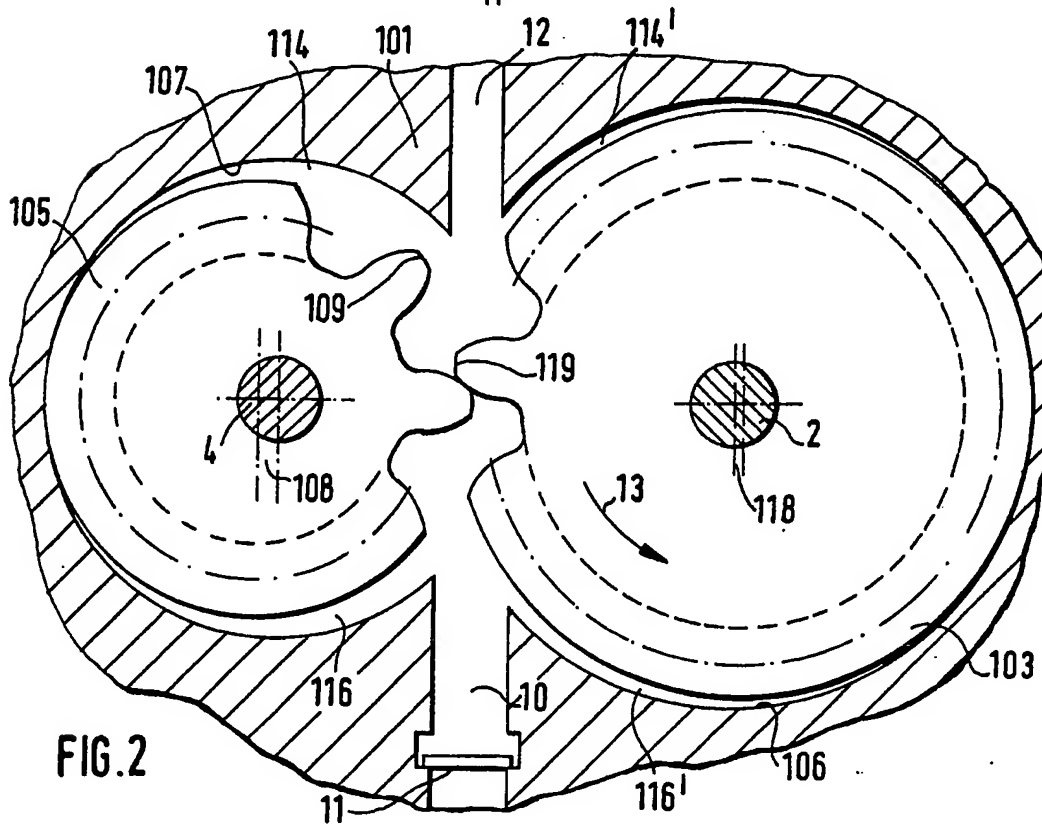
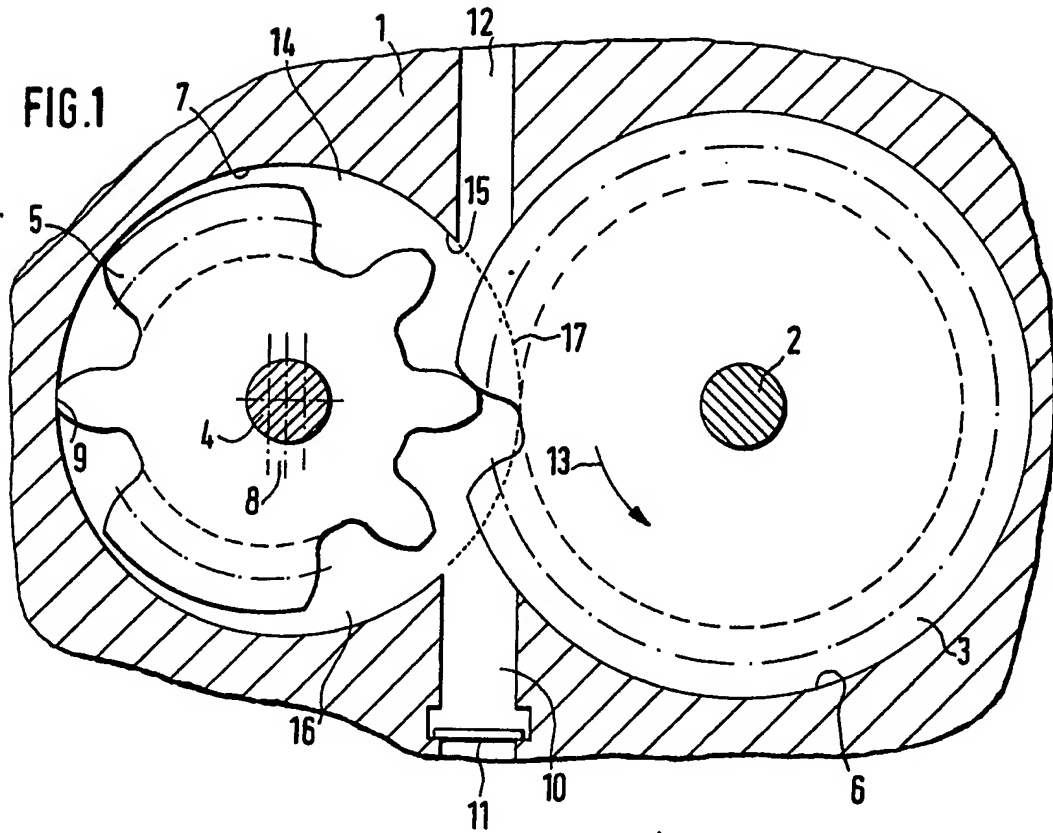
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(54) Rotary positive-displacement
fluid-machines

(57) A gear-type machine, for example a pump or motor, comprises a housing (1) and externally-toothed gears (3, 5), at least one (5) of the gears being eccentrically mounted on a respective shaft (4, 2) and thus forms variable-volume chambers (14, 16) between itself (themselves) and the surrounding interior wall(s) (6, 7) of the housing (1).



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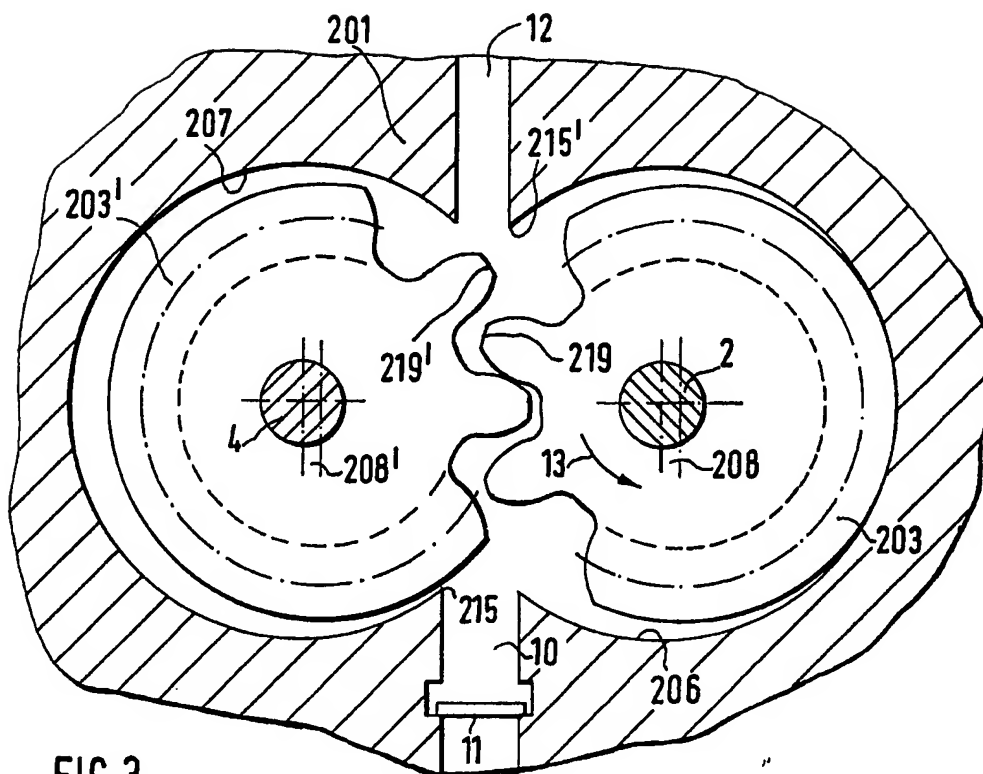


FIG. 3

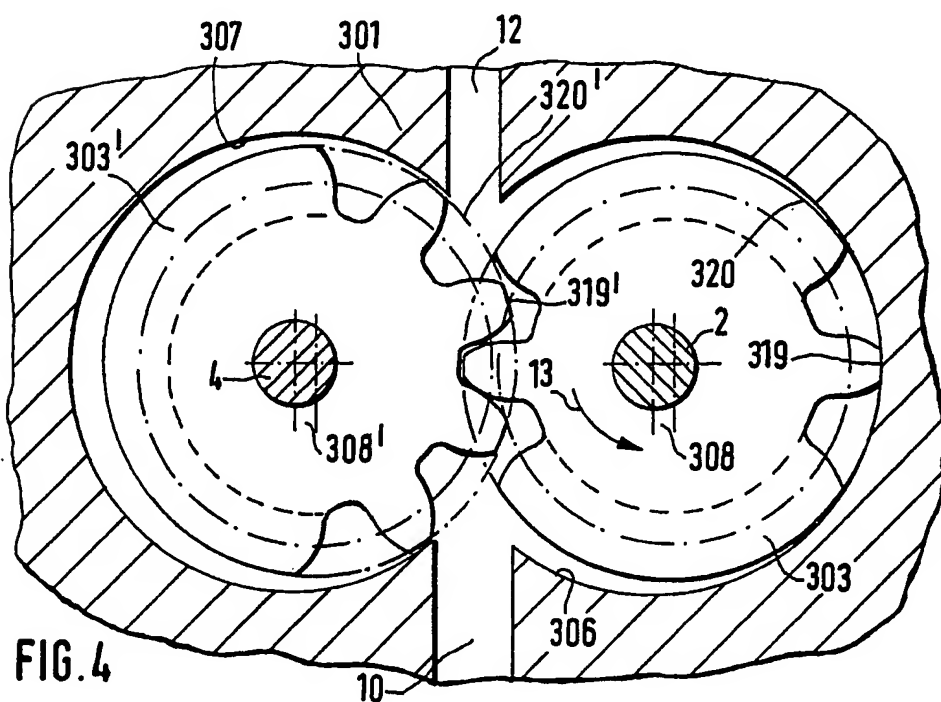
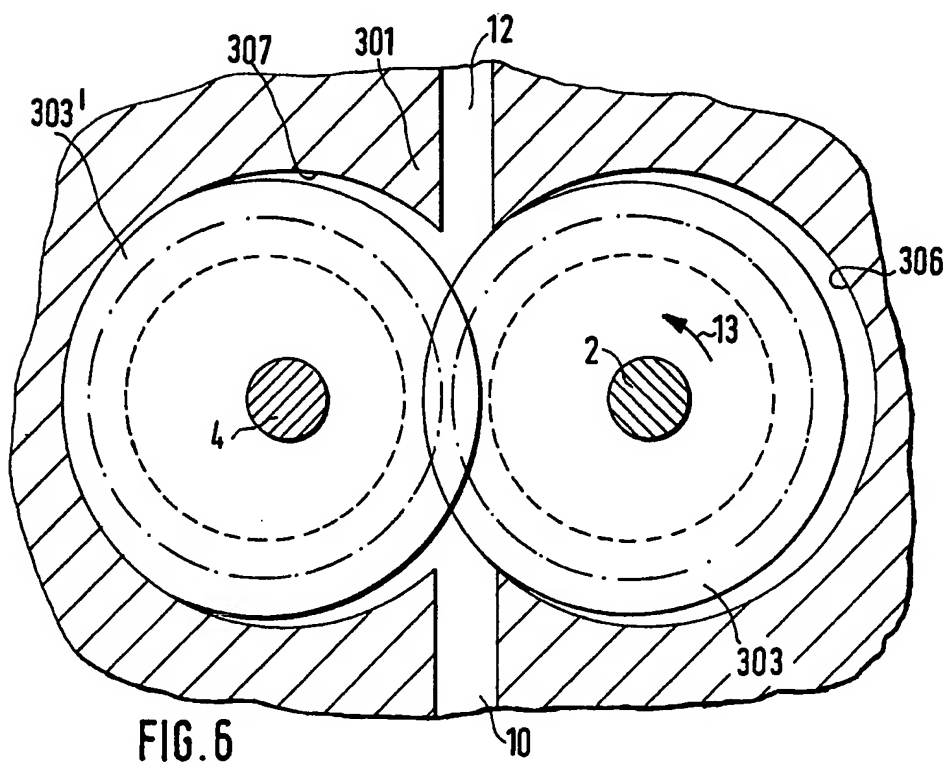
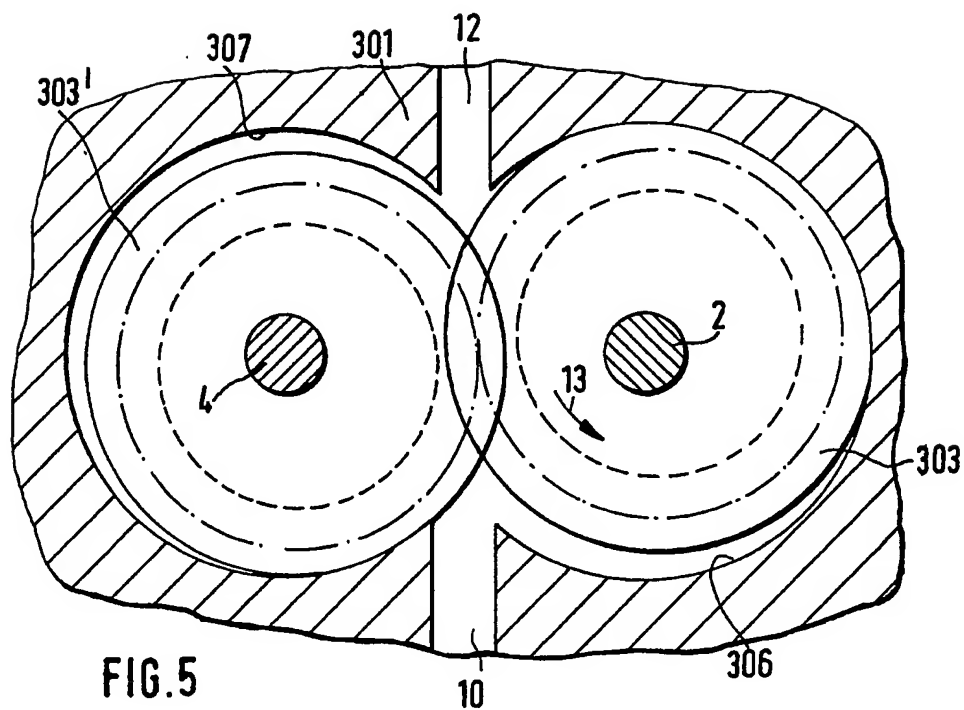


FIG. 4

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SPECIFICATION

Positive-displacement machine

5 This invention relates to a positive-displacement machine, comprising a housing and two externally toothed gears meshing together for rotation in opposite directions and arranged in the interior of the housing.

10 Positive-displacement machines may be constructed as two-axled rotary-piston machines. Known constructions are more particularly gear pumps, screw-spindle pumps and rolling-piston pumps, the latter, for example
15 as Roots blowers. The screw-spindle pumps require an extremely highly elaborate production technique; furthermore, considerable axial bearing forces occur. Even in the case of the rolling-piston pumps extremely careful production
20 is necessary in order to ensure the optimally fluid-tight co-operation of the two rolling pistons. They must furthermore be driven equiangularly and in opposite directions by a pair of gears. This means not only an increased outlay of technical resources, but also
25 imposes the necessity for a careful construction of the gear pairing. Compared to these the gear pump is found to be simple in its construction and not very sensitive to the
30 quality of the meshing teeth. However, the volumes of their tooth gaps which can be displaced with reference to the adjoining housing walls by means of their tooth gaps are comparatively small. Moreover the discontinuity of the delivery causes pressure fluctuations which *inter alia* lead to the development
35 of considerable noise.

It is proposed by the invention to achieve the aim to produce a machine suitable for
40 example, as a pump or blower, which on the one hand is of comparatively simple construction to the gear pump, but on the other hand is suitable for conveying larger volumes for comparable size and furthermore has slighter
45 delivery stream pulsation and hence generates less noise.

Accordingly, the present invention consists in a positive-displacement machine, comprising a housing and two externally toothed
50 gears meshing together for rotation in opposite directions and arranged in the interior of the housing, at least one of said two gears being eccentrically mounted on a shaft and forming, in use, revolvingly variable chambers
55 with the surrounding interior walls of the housing. It is customary to mount gears so that the theoretical axis of their teeth is simultaneously their axis of rotation. The invention, on the other hand, utilises the possibility of a
60 deliberate departure from this principle. In doing so, the particular meshing conditions must of course be taken into consideration. This can be done in manner known *per se* by profile displacement, tooth gap widening and/
65 or axis shifting.

As a further development of the invention it is also possible to mount the second gear eccentrically. This can then likewise form revolvingly variable chambers with the surrounding inner housing wall in corresponding
70 manner. In an advantageous embodiment the two cooperating gears may be of identical construction. In such a case it is found convenient to make the two gears act in the same
75 direction in their extreme position. In the case of an inner wall of the surrounding housing constructed customarily circular to the rotary axis of the gear, the tangential sealing occurs between said wall and the outermost tooth
80 crest, that is the tooth crest located opposite the eccentric mounting of the gear. As a further development of the invention it may be convenient to shorten the tooth located opposite the eccentric mounting of the gear.
85 The shortening is advantageously effected so that the tooth crest of the shortened tooth or the tooth crests of the also shortened adjacent teeth are bounded by a cylindrical surface, namely about the axis of rotation of the gear.
90 Valves may be provided in the suction and/or pressure pipe in order to prevent back flow. However, a particularly simple valveless mode of construction can be achieved in a further advantageous development of the invention,
95 by dimensioning the revolving gears so that they separate the variable chambers on the suction and pressure side permanently from one another.

In order that the invention may be more readily understood, reference is made to the accompanying drawings which illustrate diagrammatically and by way of example embodiments thereof, and in which:—

Figure 1 shows an embodiment of a positive-displacement machine constructed as a blower and having an eccentrically mounted smaller gear and a larger driving gear;

Figure 2 shows an embodiment of a positive-displacement machine with eccentric mounting of both the unequal-sized gears;

Figure 3 shows an embodiment of a positive-displacement machine with eccentric mounting of both identical gears;

Figure 4 shows an embodiment corresponding to the embodiment of *Fig. 3*, with crest shortening of the teeth located opposite the eccentric mountings; and

Figures 5 and 6 show the positive-displacement machine according to *Fig. 4* with different positions of the gears.

In the blower of *Fig. 1*, reference numeral 1 designates a machine housing, 2 a shaft of the driving gear 3 and 4 a shaft of the smaller gear 5 meshing with the driving gear 3. The smaller gear 5 is mounted eccentrically with respect to the shaft 4 and is attached to the latter. The interior housing wall 6 is concentric to the gear 3 and its shaft 2. The interior housing wall 7 is concentric to the shaft 4 of the smaller gear 5. The tooth crest 9 located
130

opposite the eccentricity 8 determines the radius of the cylindrical surface of the interior housing wall 7; the two are substantially in contact except for the necessary movement play. A non-return valve 11 is placed in a suction pipe 10. A pressure pipe 12 is provided in known manner with a smaller cross-section compared to the suction pipe 10. When the gear 3 rotates in the direction of the arrow 13, the tooth crest 9 is rotated towards the pressure pipe 12. The volume 14 enclosed between the interior housing wall 7 and the smaller gear 5 beyond its tooth gaps is then reduced until the tooth crest 9 reaches the outlet edge 15 of the pressure pipe 12. The enclosed medium is displaced into the pressure pipe. Simultaneously the volume 16 enclosed between the interior housing wall 7 and the smaller gear 5 beyond its tooth gaps is enlarged; admission occurs through the suction pipe 10. The eccentricity 8 is chosen in relation to the tooth heights in such a way that sufficient rotational flank play is still ensured in the extreme position of the smaller gear illustrated. The crown circle 17 for this position of the smaller gear is indicated by a dotted line.

A possible embodiment of a pump, in which both co-operating gears are eccentrically mounted, is shown in Fig. 2, where the details adopted from Fig. 1 are designated by the same reference numerals. The machine housing 101 has cylindrical interior housing walls 106, 107 co-axially to the shafts 2, 4 respectively of the driving gear 103 and smaller gear 105. The radius of the interior housing wall 107 is again determined by the tooth crest 109 of the tooth located opposite the eccentricity 108 of the smaller gear 105, and analogously, the radius of the interior housing wall 106 is determined by the tooth crest 119 of the tooth located opposite the eccentricity 118 of the gear 103. The remarks made with regard to Fig. 1 are substantially applicable to the mode of functioning of the pump according to Fig. 2. By rotating the gear 103 in the direction of the arrow 13, the enclosed volumes 114, 114' are displaced towards the pressure pipe 12 whilst being reduced, whereas simultaneously the volumes 116, 116' are enlarged. The eccentricities 108, 118 of smaller gear 105 and gear 103 respectively, are chosen in proportion to the tooth heights so that, in every possible position thereof, an adequate overlapping of the teeth and also an adequate rotational flank clearance are ensured.

Fig. 3 shows a pump according to the invention, in which, as in Fig. 2, both gears are eccentrically mounted. With identical gears 203, 203' and hence equal eccentricities 208, 208' of the same with reference to their shafts 2, 4, the latter can be made of comparatively large construction if, as illustrated, they are provided acting in the same

direction in their extreme position. The cylindrical interior housing walls 206, 207 are again coaxial to the shafts 2, 4 and are determined analogously as described with regard to Fig. 3. In the illustrated position of the gears, the suction and pressure sides are separated only by the tooth crest 219 and housing 201. No delivery occurs. Upon further rotation of the gear 203 in the direction of the arrow 13, the tooth crest 219' of the gear 203' moves into coincidence with the interior housing wall 207 at the inlet edge 213 of the suction pipe 10. The suction pipe and pressure pipe are thereby mutually separated; delivery can occur until the tooth crest 219 on the gear 203 loses the overlap with the interior housing wall 206 on the outlet edge 215' of the pressure pipe. A phase without delivery again follows, in fact until the tooth crest 219 again moves into overlap with the interior housing wall 206 on the suction side, which is followed by a second phase with delivery; it continues until the tooth crest 219' loses its contact with the internal housing wall 207 on the pressure side, before it once again enters the illustrated position after the completion of a complete revolution.

Fig. 4 shows another possible construction of a pump which is particularly advantageous and which corresponds substantially to the embodiment according to Fig. 3. However, it differs from the latter in that the teeth located opposite the eccentricities 308, 308' are shortened. The shortening is effected so that the tooth crests are bounded by cylindrical surfaces concentric to the shafts 2, 4 and in adaptation to the cylindrical internal housing walls 306, 307 coaxial to said shafts. The gears are conveniently mutually matched with their tooth heights, eccentricities and tooth crest shortenings with respect to the internal housing walls and to the suction and pressure pipes so that at all times at least one tooth crest of the wheel 303 is in coincidence with the interior housing wall 306 and at least one tooth crest of the wheel 303' with the interior housing wall 307. This can be seen from Figs. 5 and 6, which illustrate the arrangement according to Fig. 4 in two different positions of the pair of gears resulting from further rotation of the gear 303 through approximately 45° and 180° respectively in the direction of the arrow 13. It is thereby achieved that the displacement of the volumes respectively shut off with reference to the suction side occurs alternately towards the pressure side and without interruption of the delivery; consequently no non-return valve is necessary.

It is to be understood that variations of the constructions of positive-displacement machines according to the invention illustrated in exemplary manner in the Figures of the drawings are possible, namely both as regards their conceivable use and also as regards

structural details. Thus the machine may be used not only as a pump, but also as a motor, e.g. as a liquid meter. Irrespectively of this, the drive may of course also alternatively be introduced through the smaller gear. The drive shaft may be mounted floating or at both ends. The same applies to the shaft of the indirectly driven gear. But the latter may also if desired be mounted rotatably with respect to a fixed axis. The gears may exhibit an odd number of teeth, as in Fig. 3, or have an even number of teeth as indicated in Fig. 4. In the latter case a correspondingly greatest recession of the external gear contour analogously to the maximum crest shortening, for example of the gear 303, occurs in the region of a tooth gap, for example on the gear 303'.

The gears may be balanced with respect to their axis of rotation. Obviously, identically constructed gears with eccentricities not in the same direction in the extreme position may be used. It may furthermore be convenient to provide a non-return valve also/or in the pressure pipe. In addition to the involute tooth system customary in mechanical engineering, other forms of teeth, and not only spur teeth but for example, also helical teeth may also be considered. Furthermore, measured against squeezed oil, particularly in certain tooth meshing situations, may be provided as known. It is of course furthermore also possible to extend the constructions of two-shaft machines according to the invention by appropriate series and/or parallel connection in manner known *per se* to form three or multi-shaft machines.

CLAIMS

1. A positive-displacement machine, comprising a housing and two externally toothed gears meshing together for rotation in opposite directions and arranged in the interior of the housing, at least one of said two gears being eccentrically mounted on a shaft and forming, in use, revolvingly variable chambers with the surrounding interior walls of the housing.
2. A positive-displacement machine according to claim 1, wherein both gears are eccentrically mounted and form, in use, revolvingly variable chambers with the surrounding interior walls of the housing.
3. A positive-displacement machine according to claim 2, wherein both gears are identical.
4. A positive-displacement machine according to Claim 3, wherein both the gears act in the same direction in their extreme position.
5. A positive-displacement machine according to claim 1 or 2, wherein the tooth or teeth located opposite the eccentricity or eccentricities is or are shortened.
6. A positive-displacement machine ac-

cording to claim 5, wherein a cylindrical surface concentric with the axis of rotation of the gear constitutes the boundary of the shortened teeth.

7. A positive-displacement machine according to any of claims 2 to 4 or 6, wherein the gears, the interior housing wall and a suction and a pressure pipe are mutually coordinated so that the revolving gears separate permanently from one another the variable chambers on the suction and on the pressure side.

8. Positive-displacement machines, substantially as herein described with reference to and as shown in the accompanying drawings.

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